How accurately can the relative sea level be measured?

Masters Thesis project at Chalmers, Department of Space, Earth and Environment

Variations in sea level around the earth are relevant when studying the impact of the greenhouse effect on our future climate. Onsala Space Observatory is a very important reference station in a global geodetic network. The sea level and the movements of the earth's crust are measured continuously with the best possible accuracies.

At the observatory, a tide gauge (mareograph) station has been in operation since June 2015. It then consisted of four sensors, three pneumatic sensors (sometimes referred to as bubblers) and one radar. The sensors have a specified measurement uncertainty in the data sheets of ≈ 3 mm. Additional systematic errors may increase these uncertainties. For example, variations in water salinity, affect the density of the sea water and therefore also the accuracy of the bubblers. The radar sensor may be affected by unwanted reflections from objects other than the water surface, so-called multipath propagation.

Since the start of operation additional sensors have been installed: a laser sensor in April 2016, a radar using a waveguide immersed into the water in November 2016, and a high frequency radar in September 2018.

The proposed thesis work includes systematic comparisons between the different sensors, in terms of both short and long time stability and differences that possibly correlate with the sea level values themselves. By comparing and combining measurement results from the various sensors, the goal is to understand the measurement errors specific to each one of the different sensors in order to establish one of the most accurate tide gauge stations in the world.

The Onsala Space Observatory (left photo). The tide gauge station is seen at the lower left. During the storm Sven on the 7^{th} of December 2013 the sea level almost reached the floor of the measurement hut of the station (right photo).

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